A SPECTROSCOPIC STUDY OF AN UNCONDENSED SPARK BETWEEN COPPER ELECTRODES IN THREE DIFFERENT GASES AT VARIOUS PRESSURES. PART III

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Plates XIII A and B

ABSTRACT. A study is made of the uncondensed spark spectra in illuminating gas, air and carbon dioxide by using a transformer as a source of excitation Some observations concerning the development of lines, bands and continua in the spectra of the uncondensed spark are reported in the present paper

INTRODUCTION

In Parts I and II of this series (Singh and Ramulu, 1945, 1950) are discussed some aspects of the uncondensed spectra of three different gases, the illuminating gas, air and carbon dioxide and some observations have been made concerning the developments of lines, bands and continua In the studies of the uncondensed spark spectra mentioned above, an induction coil was used as a source of excitation Before taking the condensed spectra (Part II), observations regarding the uncondensed spectra were also repeated under similar conditions. It is the purpose of the present paper to report some observations concerning the developments of lines, bands and continua, in the spectra of the uncondensed spark obtained by using a transformer as a source of excitation.

EXPERIMENTAL ARRANGEMENT AND PROCEDURE

The experimental arrangements are exactly the same as discussed in Part II of the series, dealing with the condensed spark. The spectra have been photographed on a medium Hilger quartz spectrograph and the plates used were Eastman Kodak B-20 in the case of air and Ilford selochrome (orthochromatic) plates in the case of the illuminating gas and carbon dioxide

Fig. 1 (Plate XIII A) represents those taken with the illuminating gas at the pressures of 10, 5, 3, 1 and 0.5 cm* under similar conditions as the Fig. 1 of the condensed spark. Fig. 2 is a representative of those taken with air at the pressures of 38, 20, 10 and 3 cms, under similar conditions as

* Cms of mercury

TABLE I

System of bands	Illuminating gas (investigated at pressures. 10-0.5 cms)		Air (investigated at pressures 38-3 cms)		Carbon dioxide (investigated at pressures 12-0.5 cms.	
	At different pressures.	At various portions of the spark	At different pressures	At various portions of the spark	At different pressures.	At various portions of the spark.
First negative nitrogen bands.	Absent at all the pressures	Absent in all the parts	They make their appearance at a pressure of 20 cms and increase with decrease of pressure and are strongest at a pressure of 3 cms.	At all pressures they are stronger in *F*, less strong in *B* and least in *C*.	Absent at all pressures	Absent in all parts
Nitrogen second positive bands.	These bands are present at all pressures From 10 cms upto 3 cms they are equally strong; at lower pressures they become slightly weaker.	Between 10 and 3 cms they are equally strong in all the three parts, below a pressure of 3 cms they are weaker in *C* part	They are present at all pressures and are best developed between 10 and 3 cms.	At 38 cms they are stronger in *B* than in any other part, at 20 cms they are equally strong in *F*, *C* and *B* and at a pressure of 3 cms they are equally strong in *F* and *B* and weaker in *C*	They make their appearance at a pressure of 6 cms and are best developed at a pressure of 1 cm and below	They are slightly stronger in *F* than in *C*
Cyanogen violet bands.	They are present at all pressures and are equally strong upto a pressure of 3 cms below which they weaken	Between 10 and 3 cms they are equally strong in *F*, *C* and *B* and at lower pressures they weaken in *C*	Absent at all pressures.	Absent in all the parts.	Absent at all pressures	Absent in all the parts

N O γ bands	Absent at all pressures.	Absent in all the parts	They are present at all pressure and are best developed at a pressure of 10 cms	At 38 cms they are equally strong in *F* and *C* and weaker in *B*, at 20 cms they are stronger in *C* than in other parts; at 10 cms they are equally strong in *F* and *C* and weak in *B*, at 3 cms they are stronger in *F* than in *B* and *C*.	Absent at all pressures	Absent in all the parts.
CO Angstrom bands	They are present at all pressures. They increase in intensity as the pressure is decreased and are strongest at 0.5 cm.	They are equally strong in *F* and *B* and weaker in *C* at all pressures	Absent at all pressures	Absent in all the parts.	They are present at all pressures	At 12 and 10 cms they are stronger in *B* and very weak in *F* and *C*; at the pressures of 6 cms and below they are equally strong in *F* and *B* and absent in *C*.
Co third positive band at 2840Å.	Present at all pressures	Upto a pressure of 3 cms it is equally strong in *F*, *C* and *B* and below this pressure it is equally strong in *F* and *B* and weaker in *C*.	Absent at all pressures.	Absent in all the parts	It makes its appearance at a pressure of 6 cms. and is present at all pressures below	At a pressure of 6 cms it is stronger in *F*, slightly weaker in *B* and completely absent in *C*

Fig. 2 (Plate XIII A) of the condensed spark. Fig. 3 (Plate XIII B) is a representative of those taken with carbon dioxide at the pressures of 12, 10, 3, and 1 cm along with the Figs. 4 and 5 of the condensed spark.

RESULTS AND DISCUSSION

Before coming to the spectroscopic studies, some general features of the spark are described In this case the maximum pressures upto which the spark could pass are only 15, 40 and 18 cms in the cases of the illuminating gas, air and carbon dioxide respectively, as against 25, 60 and 35 cms of the condensed spark. The maximum rise of pressure in illuminating gas at a pressure of 10 cms is 1.6 cms in the case of air there is no rise upto a pressure of 40 cms and in carbon dioxide the maximum rise at a pressure of 20 cms is 0.2 cm and at a pressure of 20 cms it is 1 cm. There is, however, no fluctuation of pressure as was observed in the condensed spark in carbon dioxide

Even in this case of the uncondensed spark there is found to be rectification in the discharge tube in all the three gases used.

The line and the continuous spectra are practically absent in this case The resonance lines of copper (3247 and 3274 Å) are completely absent in illuminating gas and carbon dioxide, but present in the air spectra at all the pressures and are stronger at the ends and weaker in the middle. The carbon lines (2483 and 2298 Å) have appeared in the illuminating gas spectra at the pressure of 3 cms and in the carbon dioxide spectra at the pressures of 6, 3 and 1 cm in the *F* part only. They are absent at all other pressures. It may be pointed out that it was not so in the condensed spark spectra. The carbon lines, as present in the condensed spark, were present only at higher pressures and were stronger at the centre and weaker at the ends of the spark.

The bands are best developed both in the condensed and the uncondensed at a pressure of 10 cms in the case of air and from 10 to 5 cms in the case of illuminating gas and carbon dioxide. The general development of the bands is summarized in Table I As regards the developments of the bands, both in the condensed and the uncondensed, the air spectra are exactly alike, the illuminating gas spectra are a bit less alike and the carbon dioxide spectra are least alike In the case of the illuminating gas all the three parts (*F*, *C* and *B*) behave alike, in the case of air, *F* and *C* and in the case of carbon dioxide *F* and *B*, more or less behave alike. The *C* part is weaker below 1 cm in both the sparks and in all the three gases, and is weaker in uncondensed carbon dioxide spectra at all pressures.

The developments of CO_2 and CO_2^+ bands in the carbon dioxide spectra are rather peculiar. At 12 and 10 cms they are very much stronger in the *B* part as compared to the *F* and *C* parts ; whereas at a pressure of 6 cms they are equally strong in *F* and *B* and weaker in *C* and at a pressure of 3 cms they are strong in the *F* part as compared to *B* and *C* though they are present

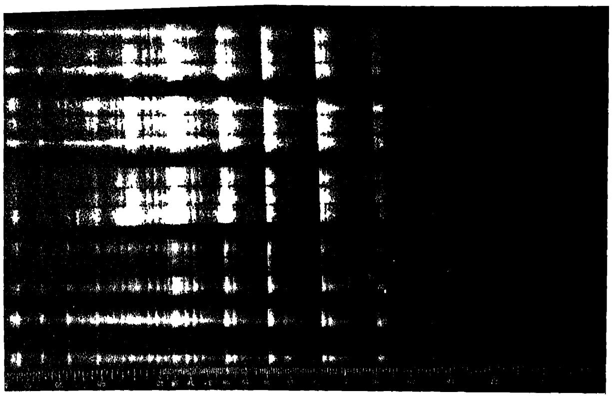

Fig 1
Illuminating gas

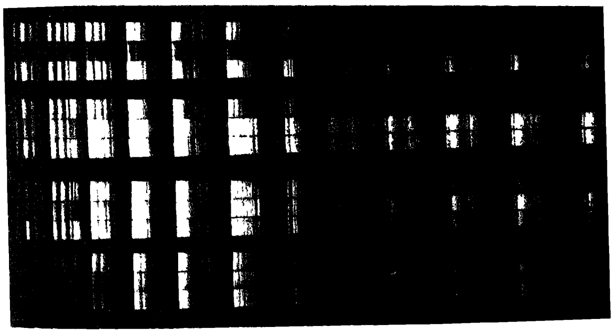

Fig. 2
Air

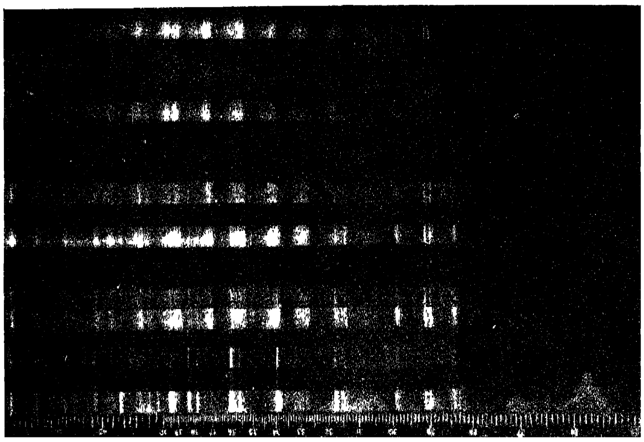

Fig. 3
CO_2

both in F and B parts. It may be pointed out that this was not so in the condensed spark spectra, where they were best developed in the B part only at the pressures of 10 and 5 cms.

The cyanogen violet bands were developed in the carbon dioxide spectra only at the higher pressures (20 and 30 cms) in the case of the condensed spark. They are, however, always absent in the uncondensed spark spectra in carbon dioxide They are always absent also in the air spectra both in the condensed and the uncondensed As pointed out in the previous publication, it is quite likely that for the development of the cyanogen violet bands a great concentration of carbon seems necessary

The complete absence of NOγ bands in the illuminating gas (containing 48% of nitrogen and 12% of oxygen) is rather surprising. As pointed out previously, it is quite likely that for the developments of these bands a very low concentration of nitrogen and oxygen in the presence of the other substances is required.

The following are some of the more important points ·

(*a*) The copper lines are all absent in the spectra of illuminating gas and carbon dioxide at all the pressures, but the resonance lines of copper are present in the spectra of air at all the pressures and are stronger at the ends and weaker at the centre There is no shading of the line in this case

(*b*) In the uncondensed spark spectra of the illuminating gas and carbon dioxide some carbon lines have appeared at the pressures of 3 cms and 6, 3 and 1 cm respectively in the F part only. They are absent at higher and lower pressures than mentioned above.

(*c*) Continuous spectrum is absent in all the gases and at all the pressures investigated

(*d*) The developments of some of the band systems, like CN, NOγ and CO_2 have been discussed

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